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A NESTING STUDY OF THE WOOD THRUSH¹

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IN Baltimore, in 1942, a color-banded pair of Wood Thrushes (*Hylocichla mustelina*) was watched for 75 hours during two nestings. All of the watching was done openly, from distances of 25 to 50 feet, the birds showing no hesitancy about their affairs.

MIGRATION AND DISTRIBUTION

Arrival and departure. The male took up territory with loud song early on the morning of April 29, the first day on which Wood Thrushes were noted in his part of the city; he was color-banded the same morning. The female, a partial albino which it would have been impossible to overlook, was first noticed on the afternoon of May 2; she was then already in company of the male and was color-banded the same day. The male was last seen July 20 and the female July 26; the Wood Thrush, as a species, was present through September 16.

Habitat. Resler (1891:106) stated 50 years ago that at Baltimore the Wood Thrush "frequents shady woods, especially near the banks of a brook or small river" and "appears to be not so well known as the majority of our other songsters, in consequence of being more solitary and shy." Weaver (1939:16) likewise stresses dampness of woodland habitat at Ithaca, New York; notes that undergrowth and saplings also seem to be necessary; and mentions an "increasing tendency" to dwell about occupied houses "in the vicinity of gorges, streams, woods, or damp places."

Dugmore (1900:169), however, found "damp or dry places . . . indiscriminately chosen" for nesting in the neighborhood of New York City, and Cooke (1929:65) found the birds much less shy, reporting that in the region of Washington, D.C., "they now nest freely about lawns in the suburbs as well as in the woods." Chapman (1940:413) also places them on "well-shaded lawns."

My own observations of the last decade in Baltimore accord with those of the latter group of writers. Shrubby or undergrowth does, however, appear to be essential—as cover for newly-fledged young.

¹ Grateful acknowledgment is made to Mrs. Margaret M. Nice for criticism during the preparation of this paper.

But I have not found the species restricted to the immediate vicinity of streams, nor have I found the woods which it inhabits to be more moist than others. In contrast to the nests mapped by Weaver (1939:17), of which the one farthest from water was only 150 feet away, the first nest of my thrushes was 800 feet from water (except for a bird bath), and other Wood Thrushes nested at even greater distances; song is common every summer in suburban neighborhoods 2,000 and 3,200 feet from water.

The habitat of my birds, 350 feet above sea level, was a block in northwest Baltimore that is lined on three sides by detached houses; on the fourth side a large vacant lot runs in deeply. That lot and most of the back yards bear a close stand of oaks—chiefly white oaks (*Quercus alba*)—70 feet tall, with also a huge elm, a smaller beech, and two or three mulberries. There are a few isolated trees between houses, and oaks in most of the front yards. The outer half of the vacant lot is heavily weed-grown, and practically all of the yards contain more or less shrubbery.

NESTS

Nest sites. Despite the comparative wildness and privacy offered by the well-wooded heart of this block, the thrushes' nests were built in trees that stood between, and close beside, houses. The second nest was 90 yards north-northeast of the first.

The first nest was placed 17 feet up in a 50-foot beech (*Fagus grandifolia*); it was set upon the base of a horizontal fork 10 feet out from the trunk, and was 10 feet from the side of a house. The second nest was 13 feet up in a scraggly 16-foot tree of heaven (*Ailanthus altissima*); it was set amid four new shoots which rose steeply from the tip of an old stem, and was $6\frac{1}{2}$ feet from the side of a house.

Building and laying. I saw none of the building or laying; incubation of three-egg clutches was under way in both nests when they were found.

Weaver (1939:16) suggests that the female chooses the nest site,² and reports a building time of 5 days. Dugmore (1900:169) gives the incubation period as 12 days. Using those figures, assuming that the eggs were laid on successive days and that incubation began after the laying of the second egg, and calculating back from the hatching dates of May 30 and 31, it appears that work on the first nest began about May 13, 11 days after the female's arrival in the territory.

Similar calculations indicate that the second nest was begun on the eighth day after the first brood was fledged, and that the first egg of the second set was laid on the thirteenth day. Weaver (1939:22)

² My color-banded male has returned in 1943, but he has a different mate: a normally plumaged bird, so far unbanded. Nevertheless, his nest is near completion only 6 inches from the site of his first-brood nest of 1942. This indicates strongly that the male selected this site. All of the building that I have seen, however, has been done by the female.

observed a fledging-to-egg interval of 16 days for one pair of Wood Thrushes at Ithaca.

INCUBATION

Amount. The eggs were incubated entirely by the female, who was on the nest for 78.0 per cent of the 940 minutes that first-brood incubation was watched and for 80.3 per cent of 1,014 minutes at the second nest. The bird's night term on the nest was about $9\frac{1}{4}$ hours. Thus the eggs were covered for approximately 87 per cent of the day's 24 hours.

Twenty-three complete sittings observed at both nests ranged in length from $7\frac{1}{4}$ to $58\frac{1}{2}$ minutes; 11 at the first nest averaged 31 minutes, 12 at the second nest averaged 27. Forty-one intervals off both nests ranged from one to 16 minutes; 22 at the first nest averaged $8\frac{1}{2}$ minutes, 19 at the second nest averaged $6\frac{1}{10}$.

Among sittings not seen in their entirety were one unfinished at the end of 70 minutes on May 28, the second day before the hatching of the first brood began, and one unfinished at the end of 76 minutes on July 6, the day before the hatching of the second brood began. These suggest especially close sitting during the last days of incubation. During a 90 minute observation period on July 5, however, sittings were of only normal lengths.

During rain. The female was once watched at incubation in the scantily-leaved ailanthus during a terrific downpour for 18 minutes, followed by a drizzle for 10. Three times in the first four minutes she half rose and then resettled herself, apparently adjusting to the torrent. For the first 13 minutes she held her head up at a 60-degree angle from its normal horizontal position, possibly to compress the plumage of the nape and so shed more water. After that she sat normally.

During high wind. While incubating in the spindly ailanthus tree the female was also watched for 80 minutes during a period of strong puffy winds. The puffs now and then carried the nest, atop the slight and almost vertical stem, over an arc of from three to at least five feet; twice the nest was carried so far that it tilted downward at 45 degrees, and once it almost stood on edge.

The lesser puffs did not seem to inconvenience the bird; she even rose during two of them and stretched her wings and legs. But two of the three extreme swings appeared to throw her off balance: she stepped out to one of the supporting shoots while the tilt was greatest, and then back on again. She moved unhurriedly, and it seemed each time that the eggs must spill before she returned to the nest.

Male's activities during sittings. During the female's sittings on her first clutch the male usually occupied himself out in the territory, foraging, singing, preening, or just idling. Two trees on the edge of the oak grove, 75 and 85 feet north of the nest-beech, were favorite perching places, no doubt because they commanded a clear view of the beech

and so enabled him to see when the female left to feed. For it was usually only upon her departure that he went to the nest to stand guard. A few times, too, he kept his guard from these oaks.

Not infrequently, though, the male spent some time in the nest-tree itself while the female was on these first-brood eggs: periods that ranged from a few seconds to almost half of the sitting. During these periods he might preen a bit, or simply stand idle, but was only once observed to sing (for seven minutes of a nine-minute stay).

The male's activities during the female's second-brood sittings differed in two ways: he was still feeding the first-brood young during the first week of incubation and, even after he had become free of that task, he spent no time in the nest-tree with the female. Since he did once perch for five minutes on the roof-edge some yards above the second nest, it may be that this change in behavior was not only part of a general decrease in attentiveness during the second nesting but was due in some degree to the smallness of the ailanthus; in the beech he had usually perched 10 feet away from his mate, and no such distance was possible in the ailanthus.

His favorite perches during second-brood incubation were 50 feet north and 90 feet south of the nest; the first commanded a view of the nest, the second did not.

Male's activities between sittings. When the female left the first-brood nest to forage, the male almost invariably kept guard over it, usually from the rim of the nest or some perch in the home tree. Sometimes he sang during part of his watch—twice he sang half a dozen phrases while standing on the nest-rim, and another time sang for two minutes while standing just beside the nest. During only one of the female's 22 absences while this nest was under observation was the male neither seen nor heard.

At the second nest he stood guard during only 12 of the female's 19 observed absences. In doing so during 5 out of 8 while he still was feeding first-brood young he set a surprisingly good record; however, after becoming free of feeding duties he maintained only that reduced ratio, guarding during 7 of 11 absences, so that here, too, a decrease in attentiveness appears. Another difference in behavior was that he never sang while on guard in the second nest-tree, although he did sing a few times from other guard stations nearby.

Hatch. Of the first clutch, one egg hatched May 30 and the other two May 31. The second set of three hatched on three successive days, July 7 to 9. The hatching hour was determined for only one egg (the last one to hatch of the first set): 2 hours 17 minutes after sunrise, at 6:59 A.M. The female was sitting at the time, and she flew away south-westerly with half of the shell; three minutes later, while she was still away, the male alighted at the nest, made a feeding, and then carried the other half of the shell away northward.

BROODING

Amount. The female alone brooded the young. She did so on every day of their nest life, and also at night—whether throughout every night was not determined, but the persistence of her diurnal brooding makes that seem probable.

She covered her first family for 62.8 per cent of 641 minutes' observation, during which the temperature range was 61° to 85° F. and the skies varied from clear to misting. She covered her second family for 45.5 per cent of 610 minutes' observation; mere attendance, during hot weather, raised her total time at this nest to 72.7 per cent. The temperature range during these observations was 73° to 95°, the skies clear.

There was no progressive daily decrease in brooding at the first nest, nor any clear correlation between weather and amount of brooding. These statements also hold for the second nest, except at temperatures of 93° and above.

At 93° and above, both the female and the nestlings showed discomfort by holding their bills open more or less of the time, and the female did almost no actual brooding but simply stood for 46.5 to 85.0 per cent of the time on the nest's rim or on a branch beside the nest—but, *curiously enough, never on the sunward side, where she would have shaded the young.* On some days this behavior was continued beyond the period of extreme heat—until the temperature had fallen as low as 88°.

FEEDING

Sharing of work. Both parents fed both broods of young both in and out of the nest, but the male fed them much more often than the female. He made two-thirds of the feedings while each brood was in the nest, and almost all the observed feedings after each brood left the nest.

Length of day. I observed when second-brood feedings started on one morning (at 4:27 A.M., 24 minutes before sunrise), and how late they lasted on one evening (until 7:42 P.M., 8 minutes after sunset), which would suggest a feeding day of 15¼ hours. Both observations were made in clear weather.

Rate. During 826 minutes that feedings were watched at the first-brood nest, 120 trips were made with food: 78 by the male, 40 by the female, and 2 by an undetermined parent. At least five times the male fed two nestlings on one visit, and at least three times the female took part of the food he brought and fed an extra nestling. Counting 128 feedings, then, the average interval was 6.4 minutes, and the rate of feedings was 9.3 per hour for the brood of three.

During 813 minutes of feedings at the second nest, 61 trips were made: 42 by the male, 16 by the female, 3 by an undetermined parent. The male at least twice and the female once fed two nestlings on one

visit. Counting 64 feedings, the average interval was 13 minutes for this brood of three, a rate of 4.7 feedings per hour—just half the rate for the first brood.

No steady increase in feedings from day to day was noted at either nest.

Despite the difference in their observed feeding rates, with no perceptible difference in the size of meals, the second brood left the territory when 10 to 12 days old, the same age at which the first brood left the nest—equivalent acts, since the first brood obviously could have been led away at once had not the second nest held the parents to the territory.

Male's feedings. Because the female brooded so much, she was usually on the nest when the male arrived with food. At the first nest the female generally stayed during the feedings, and it was not unusual for the male to make two or three trips during single sittings. At the second nest, on the other hand, the female almost always flew away as soon as the male arrived.

When the female left the first nest upon his arrival, the male sometimes kept guard until her return, as he had done when there were eggs, but he was never seen to keep guard for the full interval after a second-brood feeding. At both nests he occasionally stood guard during just a part of the female's absence, then disappeared, and at both he occasionally made repeated feedings—as many as five—while she was away. Now and then he made two feedings before beginning guard duty at the first nest.

Female's feedings. At both nests the female made her feedings almost exclusively upon returning from her own meals to resume brooding. At the first nest she brought food on almost all of those returns; at the second nest, on less than half of them. Not until the latter part of each brood's stay in the nest did she occasionally make one feeding, then fly directly away to find more food.

Female "trims" food. On the first few days of the nestlings' life the female took some pains to see that their food was readily digestible. She herself gave them only caterpillars and very small insects, and she kept an eye on the male's offerings. If he, too, had brought a caterpillar or particularly small insect she let him feed the young at once, but when his catch was an insect of any size, she picked off, and herself ate, such parts as the head and wings before rising and letting him feed the young. That procedure was seen on both of the first brood's hatching days, and again on the day the birds were three and four days old. It was seen once on the day the second brood was four to six days old.

On June 30, which was about the sixth day of second-brood incubation, there occurred an incident that seemed to be an anachronistic instance of food "trimming." While the female was sitting, the male alighted beside the nest with a caterpillar. The female arose, dabbed in the nest for some seconds, then in accordance with normal behavior

flew away to forage. Still holding the caterpillar, the male stood guard for 11 minutes. Then as the female returned he moved slightly so as to face her squarely and, after she had again used her bill briefly in the nest, she pulled the head off the caterpillar and ate it and immediately the male swallowed the remainder. This incidentally, was the only time that a caterpillar was seen to be trimmed.

Feeding troubles. Food which one nestling could not or would not swallow was taken from it and given to another bird. A caterpillar had been brought to the nest by the male. When it remained partly visible in the mouth into which he stuffed it, the watching female pushed or pulled at it several times. Then, that youngster still failing to swallow it, the male withdrew it and fed it to another.

On two other occasions parents misjudged the swallowing abilities of their young. The male once placed a mulberry in a nestling's mouth crosswise and had to pick it up and replace it twice before getting it in lengthwise so that it could be swallowed. Again, one adult (I believe the male) of a pair crossing the study territory with young tried three times to jam into the mouth of one fledgling a cherry too large for it even to hold, and only after these repeated failures began tearing the fruit to pieces and feeding it that way.

Out-of-nest feedings. After the young had left the nests, feedings were seen as follows: First brood: by the male, 28, of all three birds; by the female, 2, of one bird. Second brood: by the male, 10, of two birds; by the female, 2, of the third bird.

In addition, on the ninth day after her first brood left the nest, the female was once seen to feed one of two strange juveniles which with their parents had come into the territory four days earlier.

Posturing rare. Only once was one of the fledglings noticed to flutter its wings when fed. It was then 21 or 22 days old, and it hurried across a lawn toward the male with head thrust forward, bill open, and wings fluttering. A juvenile of the trespassing family likewise was seen just once to flutter when fed. No such behavior was seen while the young were in the nests.

Nature of food. Distinguishable food given the young during their nestling days was: hairless caterpillars, earthworms, red mulberries, white mulberries. Distinguishable food after they left the nest was: Japanese beetles, white grub, earthworm, hairless caterpillar, red, white and unripe mulberries.

NEST SANITATION

The nestlings' feces were almost always eaten by the parents, but a few times were carried away. When the female remained at the nest through feedings by the male, he did not wait for the excreta to appear.

The two or three occasions on which excreta were carried away—by both parents—all fell during morning twilight, although this was not the usual manner of disposal at that time of day. During my only

period of evening twilight observation, all excreta were eaten. At a nest of Robins (*Turdus migratorius*) which was studied sketchily, the one time out of six that excreta were carried away instead of being eaten also fell during morning twilight.

THE YOUNG

Fledging. All of the first-brood young left the nest June 12, when they were 12 and 13 days old. All of the second-brood young left the nest prematurely, upon being banded July 17, when they were 8 to 10 days old.

Flight powers. I did not see the young birds' very first flights, but on its initial day out of the nest one of the first-brood young made a flight of about 25 feet from a low bush to a perch 10 feet up in a tree. Two days later this brood was flying strongly. A juvenile of another pair flew 50 feet on a level course on its first afternoon out of the nest; that appeared to be the extent of its powers.

Habitat. On their first day out of the nest the first-brood young resorted to bushes, perching about three feet above the ground. Two days later they were found in trees, and positions 8 to 15 feet above the ground remained the rule until a week later when they began to do some of their own foraging. Thenceforth they divided their time between trees and the ground.

The second-brood young also showed the tendency to get above the ground. Having left the nest before they could fly, these birds were unable to get up into bushes, but on their second day at large they began to perch on stones a few inches high, and on spots a few inches up in fallen bush, which they could reach by climbing.

Dispersal. While entirely dependent, the fledglings whenever they could be found were scattered over the territory 28 to 60 yards from each other. After they began to do some of their own foraging, any two of the three first-brood birds might be found travelling together, either by themselves or in train of a parent.

When the young finally left the nesting territory they appeared to do so singly. Two first-brood birds remained four days longer than the third and then vanished seven hours apart. Two second-brood birds left something more than two hours apart, the third not until a day later; the first of these three and the adult female disappeared simultaneously and probably together, for the female was attending this bird when last seen; the male and the third juvenile likewise vanished at the same time; I have no idea whether the middle youngster, which had meanwhile disappeared, went over to the departed female's care, or was still under the male's and merely undiscoverable.

Period of dependency. At least one of the first-brood young was doing some of its own foraging by the age of 20 days, and all were by the age of 23; one still was fed when 31 or 32 days old, and the others

at least as late as 25 to 28 days. Last seen in the territory when 28 to 32 days old, all of the first brood presumably were independent when they left the area.

NUMBER OF BROODS

Bailey (1913:351) states that "sometimes" two broods are reared by the Wood Thrush in Virginia. Weaver (1939:22) reports two broods raised by a pair at Ithaca, New York. Two seem to be the rule at Baltimore; Resler (1891:106) so judged from late dates for newly-fledged young, and not only did the subjects of my study raise two broods, but the color-banded male of a neighboring pair which fledged birds in mid-June was still casually observed through July 29, and in song through July 26, dates which suggest that he also nested again.

Weaver, watching a marked pair of birds, found as I did that the same ones remained together for the second nesting.

TERRITORY

The initial territory was practically identical with the area described under *Habitat*. It included all of that city block except one edge, where paved driveways and a comparatively close placing of buildings reduced the amounts of lawn and shrubbery. This territory was just about 100 yards square. Other Wood Thrushes nested in all of the surrounding blocks; the one other nest that I searched out was a first-brood one 80 yards south-southeast of the study pair's first nest.

Between the two nestings there appeared to be a slight extension of territory northward, and when the second nest was built on the north edge of the original territory the birds made a pronounced extension in that direction, the neighboring thrush on the north having apparently moved away. The new territory was not determined precisely, but the birds—freely crossing a paved street—were seen to go at least 75 yards northeast of their second nest, while they also held onto the heart of their original block. Their final territory, therefore, must have been something like 125 x 100 yards.

These were suburban territories, then, of about 2 and 2½ acres; Weaver (1939:18) found territories in stream-side woodland to range from ½ acre to 2 acres.

Other birds nesting within these territories were: a number of pairs of Robins, a number of pairs of Starlings (*Sturnus vulgaris*), some English Sparrows (*Passer domesticus*), a pair of Catbirds (*Dumetella carolinensis*), a pair of Blue Jays (*Cyanocitta cristata*), and almost certainly a pair of Chewinks (*Pipilo erythrophthalmus*).

During both nestings there were innumerable encroachments upon territory by other Wood Thrushes. The interlopers used a bird bath, foraged, and sang on the edges of the study-pair's land, and usually with impunity since the nesting birds could not be everywhere at once. The outstanding invasion was one made between broods by another pair

with two semi-dependent young; this family stayed in the territory for five days and roved over practically every part of it. One of that pair, apparently the female, was a color-banded bird.

The nesting female was seen to defend territory twice and the male four times. On the other hand, the female once allowed a strange Wood Thrush to perch for half a minute and utter some little calls only three feet below the nest on which she was incubating her second set of eggs; she once foraged peaceably near the "female" of the trespassing family, and, as already noted, she once fed one of that trespasser's young. The male also once tolerated this "female," though he defended territory against its mate and one of its young.

The female's first defense of territory was seen May 10. She flew at a stranger on the ground a few times and then pursued it mildly as it withdrew from the territory. Her other defense was seen July 4: a stranger appeared on the ground 15 yards from the nest, and the female flew off her eggs with a burst of *quit* calls; she then hopped in pursuit, uttering at intervals a short explosive cry that had a musical quality and suggested rudimentary or vestigial song. About 20 yards from the nest, although the stranger was certainly still in the territory, the female turned back and began foraging; the other bird then disappeared.

Three of the male's four defenses were made against the trespassing family in the period between the two nestings. Once he flew at the supposed male and chased it out of the territory; once he seemed to be satisfied when by hopping toward this trespasser he made it retreat a short distance, for he himself thereupon flew away in the opposite direction. The other two defenses were more interesting, one because it seemed to be made against a juvenile, and the last because it was a battle of song.

In the case of the juvenile, the study male was in a mulberry tree when the "female" trespasser and her two young appeared on the ground below. After a minute and a half the male flew at the little group, and one of the juveniles fled. The other two birds paid no attention to the attack, and the study male then began to forage peaceably only a few yards from them.

The battle of song lasted seven minutes, and the nesting male was victorious. It occurred the morning of July 1, while the female was sitting on her second set of eggs. Thirty yards south of the nest the male was singing intermittently: song which at this date was no longer first-class, but rather weak in volume and slightly slow in pace. For 10 minutes he sang, then he changed to a variety of calls for half a minute, then he disappeared, and just as he did so a strange adult was noticed on the ground beneath his tree, and one of the study male's first-brood juveniles in another tree nearby. Soon the stranger flew up near the juvenile. In a little while the nesting male returned. He fed his offspring, then darted at the stranger, who fled to a tree some distance southwest, giving several phrases of song on his way. The nester, after

his little dash, alighted again near his juvenile and launched into loud, fine song. Almost at once the stranger also began singing loudly. At that, the nester moved to a tree nearer him; and when, after some minutes, the stranger made a slight advance, the nester also moved forward another short distance, so that finally the birds were singing only 8 or 10 yards apart. Seven minutes after the struggle by song began, the stranger apparently admitted defeat by turning silent, and presumably he flew away—he had been hidden by foliage at the last. The nesting male sang on for a quarter-minute more, then returned to his normal affairs.

These Wood Thrushes were very tolerant of other species in their nest-trees. While the female was sitting on her first set of eggs, Starlings three times, English Sparrows four times, and a Robin once, were seen to spend from a few seconds to several minutes in the beech without being molested. Some of those birds were in far parts of the tree, as much as seven yards from the nest, but others were only one and two yards from the sitting bird; also, some of them called, and scolded, and the Robin sang for a minute and a half. Likewise, while she was brooding her first nestlings the female permitted a couple of English Sparrows, a Starling and a Catbird to enter the tree. Once during the second nesting, while both Thrushes were absent from the tiny ailanthus tree, a Brown Thrasher (*Toxostoma rufum*) spent some seconds preening only two or three yards from the eggs without attracting either parent.

No such hostility to Robins as Weaver reports (1939:19) was shown by these Wood Thrushes; Robins nested within about 50 feet of both Wood Thrush nests, and no clashes were seen. The only birds of other species toward which hostility was displayed were a Blue Jay and a Purple Grackle (*Quiscalus q. quiscalus*), and these had not entered the nest-trees nor made any move to do so. On the first brood's last morning in the nest the female interrupted her covering of them when a Jay appeared, foraging and calling, in a tree 25 yards away. She flew to a wire near that tree; soon the male also appeared, and both began steady calls of concern; then the male flew into the Jay's tree and continued his calls there. Some Robins and a Catbird were attracted, and they joined in the scolding. None made any attack, however, and after three minutes the Jay flew away of its own accord. In contrast, on the second day of the second-brood hatch, a Jay which appeared briefly only 10 yards from the nest was engaged by a Robin, but the female Wood Thrush continued to sit and the male did not appear. The Grackle was attacked by the male when it appeared on the ground 10 yards from the second nest, which then held young 4 to 6 days old; the Thrush flew at the Grackle several times, and in a minute or two the Grackle went away.

VOICE

MALE. The male sang regularly from his arrival on April 29 through the morning of July 8, which was the second of the three days of second-

brood hatching. After that, he was observed to sing only July 12 and 15, and then only a few poor phrases. Other Wood Thrushes sang with considerable regularity as late as August 2; the last song was heard August 15. Weaver (1939:20) states that at Ithaca "there was song in the evening only, after the young had left the nest"; there was song in my bird's territory every morning of the period between broods, and the singer was once searched out and confirmed as the breeding male. Other notes given by the male were:

Cheuh-heuh-heuh-heuh. The commonest call; sometimes one or two syllables longer or shorter; unaccented or the last syllable slightly accented. Apparently the call which Weaver writes "Trrrrrr." Used, as she records, to indicate uneasiness, and also apparently as a location note.

Strings of as many as five "quit's." These are the *pit* and *quirt* notes to which Chapman (1940:413) and Weaver (1939:19) give opposite meanings, and which seem to vary slightly in sound only because of differences in force of utterance. Sometimes given calmly, and the meaning then not clear. Usually given very loudly and excitedly, and then they indicated great distress and served as a battle cry and a call for aid.

Heeh. Always given singly. Possibly denoted excitement. This apparently is the "squeaky whistle" listed by Weaver, but it was never used during my observations to urge the female off the nest or to urge the young to eat, as noted in the Ithaca study.

A low-pitched rattle or trill varying in length. Meaning unknown. Given three times as the male flew from the nest-tree: twice upon the female's return from a foraging trip, ending his guard duty; once upon his departure seven minutes after she had returned from foraging. On one of the occasions the nest held eggs, on two it held young. Another male was once observed to give this note under similar circumstances: as he flew from a guard post near his nest-tree upon the female's return to their young.

FEMALE. The female used the *cheuh-heuh-heuh-heuh* call in the same ways as the male. Once she gave one or two of these calls while standing beside the nest, and twice she gave one immediately after going on the nest to incubate. A queer-toned variant, more nearly a whistle than usual, was given by her several times when I approached her fledged young, and once when the squeals of an unrelated young Wood Thrush attracted her to the banding trap.

The strings of loud and excited *quit's* also were given by the female: once while defending territory against another Wood Thrush, and a number of times as she struck at a small mirror mounted on a pole, which was used to see inside her second nest. Similar uses of these notes are recorded by Weaver.

The only other note heard from the female was the explosive and somewhat musical one uttered during a defense of territory and already mentioned under *Territory*.

YOUNG. The first-brood young were not heard to make a sound until their last morning in the nest, when at the age of 12 and 13 days one or more gave some little *chip's* or *chik's*. The young—exact age unknown—in another first-brood nest were giving such calls on the day before they took wing. The study-birds' second-brood young were silent throughout their nest life; however, as soon as they left the nest (prematurely, at the ages of 8 to 10 days), they began uttering this same note—a fact which shows its character as a location call. I recorded this note at various times as *tsih*, *chik*, *chip*, *tsip*, *tseep*, and *cheep*, its quality depending considerably upon its volume.

When last seen (at the ages of 10 to 12 days), the second-brood young were still giving the above note exclusively. By the age of 21 days, when they were partly independent, the first-brood juveniles had begun to give *tih-tih's* as well, and soon these calls were lengthened to three, four and even more syllables, so that they seemed to be a rudimentary form of the adults' *cheuh-heuh-heuh-heuh*. The earlier *chip* notes were continued, however, to the age of at least 32 days, when these juveniles disappeared.

A loud burst of *quit's* identical with those of adults was given by a fledgling just a few hours out of the nest, when it was chased.

ALBINISM

The female's albinism consisted of one white feather in the crown a short distance behind the right eye, some white feathers among the upper tail coverts, and four white rectrices. The six young of the two broods were color-banded while still in the nest; no sign of albinism was seen up to the age of 32 days with the first brood, 12 days with the second.

Knight (1940:574) states that among ten broods of young raised in five years by a partly albino (male?) Robin there were no albinistic birds. Smith (1934:109) reports that albinistic touches did appear in the offspring of a partly albino female Robin.

SUMMARY

A pair of color-banded Wood Thrushes in suburban Baltimore remained together through two broods of three young each; nesting success was 100 per cent.

The second nest was built 90 yards north-northeast of the first; the general locations of the two were similar; the placements differed.

The immediate proximity of a stream was not found, as by some other observers, to be a habitat requirement.

The female alone incubated. Attentive periods at the first and second nests averaged 31 and 27 minutes, respectively; inattentive periods $8\frac{1}{2}$ and $6\frac{1}{10}$ minutes; the percentage of daylight hours spent on the nest was 78 and 80.3.

The incubating bird's behavior during rain and during high wind is described.

The first-brood hatch extended over two days, that of the second brood over three. The hatching hour of one egg was 6:59 A.M., 2 hours 17 minutes after sunrise. The shell was carried away.

The female alone brooded the nestlings. Brooding lasted throughout the young's nest life. No progressive daily decrease in the brooding was found, nor any clear correlation between weather and amount of brooding except at temperatures of 93° F. and above, when attentiveness changed from covering to mere attendance—without shading.

Both parents fed the young. The male made many more feedings than the female, but the female showed the better appreciation of the nestlings' needs; on the young's first days she gave them softer food than did the male, and she also trimmed certain portions away from some of the food he tendered.

During comparable series of observations the average rate of feedings at the first nest was 9.3 per hour, at the second nest only 4.7, with equivalent food loads.

Both parents were somewhat less attentive to the second brood than to the first. For example, the male guarded the first nest between almost all of the female's sittings, but guarded the second during only 60 per cent of her absences. At the first nest single periods of brooding by the female often encompassed two or three food trips by the male, but the female almost always flew away from the second nest the moment her mate arrived. The parents were equally responsible for the 50 per cent drop in feeding rate from brood to brood.

The nestlings' excreta were usually eaten, by both parents, but two or three times, during morning twilight, were carried away.

All of the first brood left the nest on the same day, when 12 and 13 days old. These birds were doing some of their own foraging by the age of 20 and 23 days; they continued to be fed by the parents to the age of 25 to 32 days; they left the territory, presumably independent, at 28 to 32 days.

Two broods seem to be the rule at Baltimore.

First-brood territory was about 100 x 100 yards in extent, second-brood territory probably 100 x 125 yards.

Both adults defended territory against their own species, but not especially vigorously; the observed defenses are described. On the other hand, the female once fed a juvenile of a trespassing family that remained in the territory five days. The study pair were very tolerant of several other species, displaying hostility only toward a Blue Jay and a Purple Grackle.

The notes uttered by male, female, and young are described, with comment on their uses; the female's use of a note suggesting song is mentioned.

Partial albinism in the female was not inherited in the juvenal plumage by any of the six young.

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BIRD DISPLAY. AN INTRODUCTION TO THE STUDY OF BIRD PSYCHOLOGY. By Edward A. ARMSTRONG. Cambridge at the University Press; Macmillan Co., N.Y. 1942: 5½ x 8½ in., xvi + 381 pp., 22 pls. \$5.50.

The study of bird psychology has only recently emerged from its anecdotal, anthropomorphic stage, and this excellent handbook will probably surprise many students, who, because the literature has been so extremely scattered, have not realized the extent of the progress we have made. Armstrong has not only assembled, correlated, and interpreted this literature, but has wisely included the full references which provide the evidence for his statements. If we question a generalization, we can promptly turn to the original sources and form our own conclusions.

The author's fine admonition to students of bird behavior demands quotation in full:

"An interesting observation of a bird's behaviour should be no less carefully recorded and reverently preserved than the type specimen of a new subspecies. Lack of regard for this principle has long prevented the outdoor study of birds from being considered much more than the harmless hobby of men who preferred looking at birds to killing them. Now that field ornithology is increasingly recognised to be a serious scientific discipline from which careless observation and wanton generalisation should be sternly excluded, it is essential that its literature should eschew the vagueness which has hampered the progress of bird-behaviour studies in the past. It is not enough to be told that birds do this or that; we should be told what reliable observer has seen them do it."

This book contains such a profusion of quotations from many sources that inevitably some will be criticized by any reader. There is, for example, the description of the dance of the Sharp-tailed Grouse (p. 73), which is based on a long out-dated, and in part anthropomorphic, account, and to which Armstrong adds a probably erroneous statement. One even turns up (p. 13) the old misconception of birds sleeping with the head under the wing. But perhaps the worst example is the quotation in full (p. 185) from a recent best-selling novel (!) of an apparently imaginary description of the dance of the Whooping Crane.

The book is handsomely illustrated with 40 photographs by the author and others. There is a bibliography of nearly 700 titles, a good index, and a separate list of the scientific equivalents of all bird names used in the text.—J. Van Tyne.